Strained $SrTiO_3$ Films

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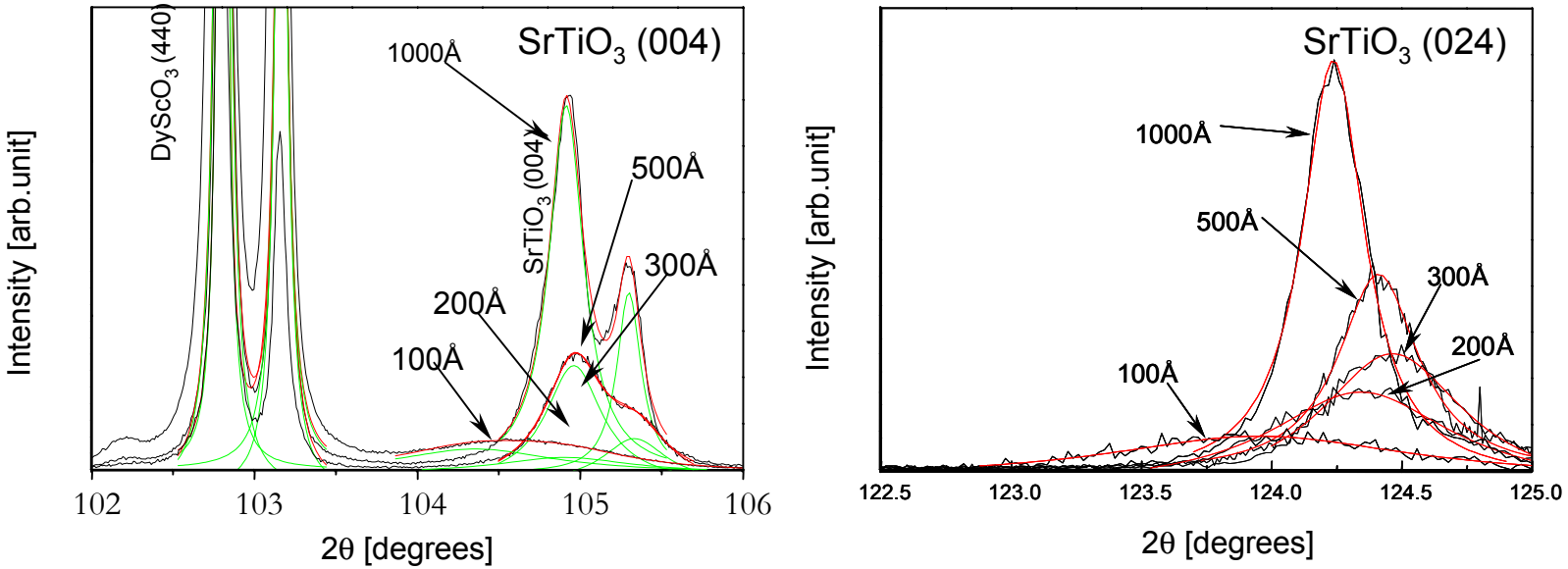
- SrTiO3 (i.e., Ba1-xSrxTiO3, x =1) is known as an incipient ferroelectric material, in which the ferroelectric phase transition is suppressed by quantum fluctuations and the non-linear dielectric properties are present only at very low temperatures (i.e., below 65K).

- The control of strain in SrTiO3 provides a basis for room temperature tunable microwave applications by shifting its phase transition peak to room temperature.

- The room temperature dielectric constant and tunability of strained SrTiO3 films have been measured at 6000 and 75%, respectively, with an electric field of 1V/μm.

X-ray data for different thickness $SrTiO_3$ films

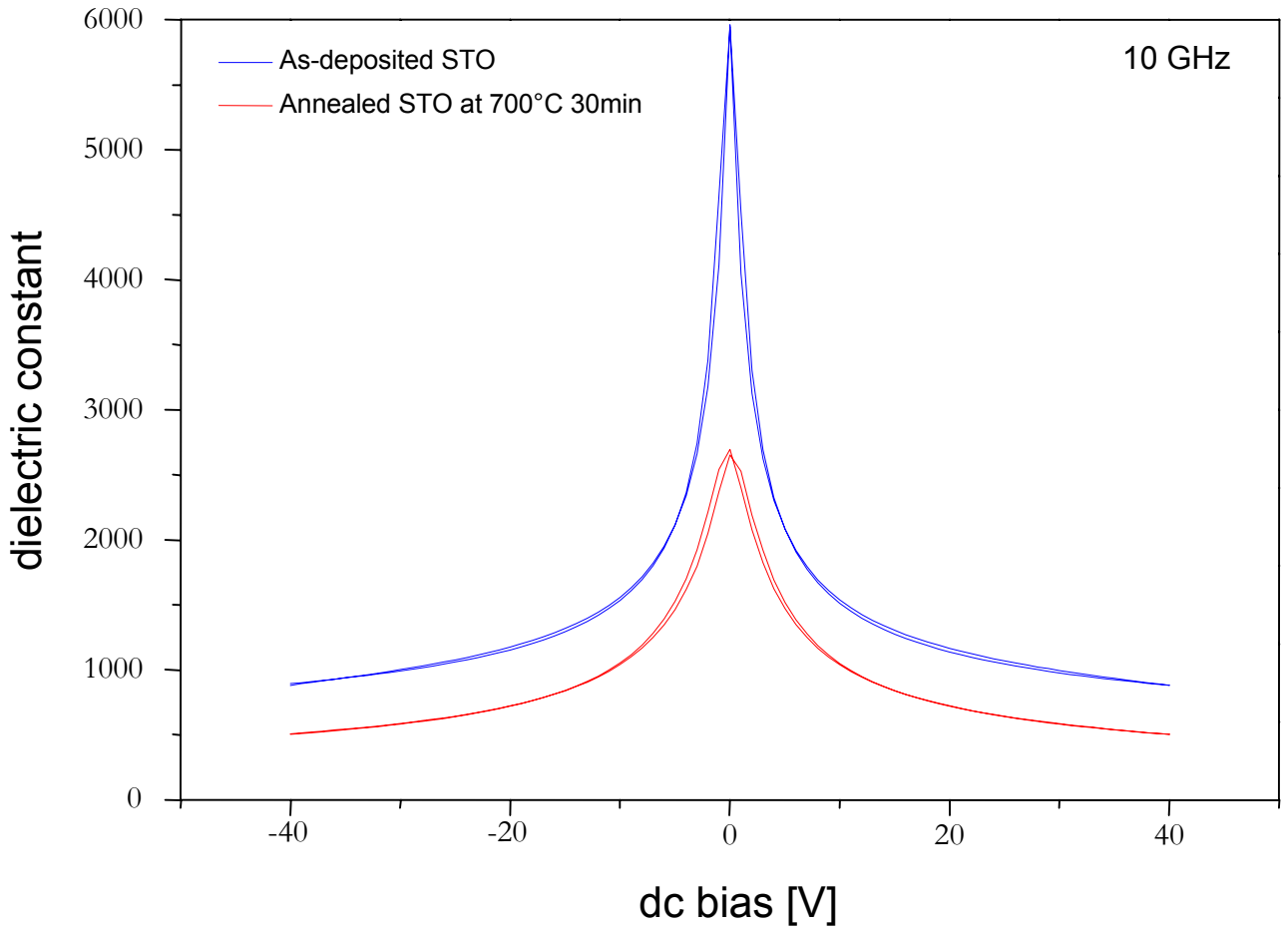


In-plane and out of plane lattice parameters

thickness[Å]	$a_{\text{in-plane}}$[Å]	FWHM($k_{\alpha 1}$) [degrees]	a_{normal}[Å]	FWHM($k_{\alpha 1}$) [degrees]
1000	3.941 ±0.001	0.3	3.883 ±0.001	0.2
500	3.932 ±0.002	0.4	3.882 ±0.001	0.3
300	3.931 ±0.003	0.7	3.882 ±0.002	0.4
200	3.937 ±0.004	0.9	3.881 ±0.002	0.5
100	3.909 ±0.007	1.4	3.896 ±0.005	1.0

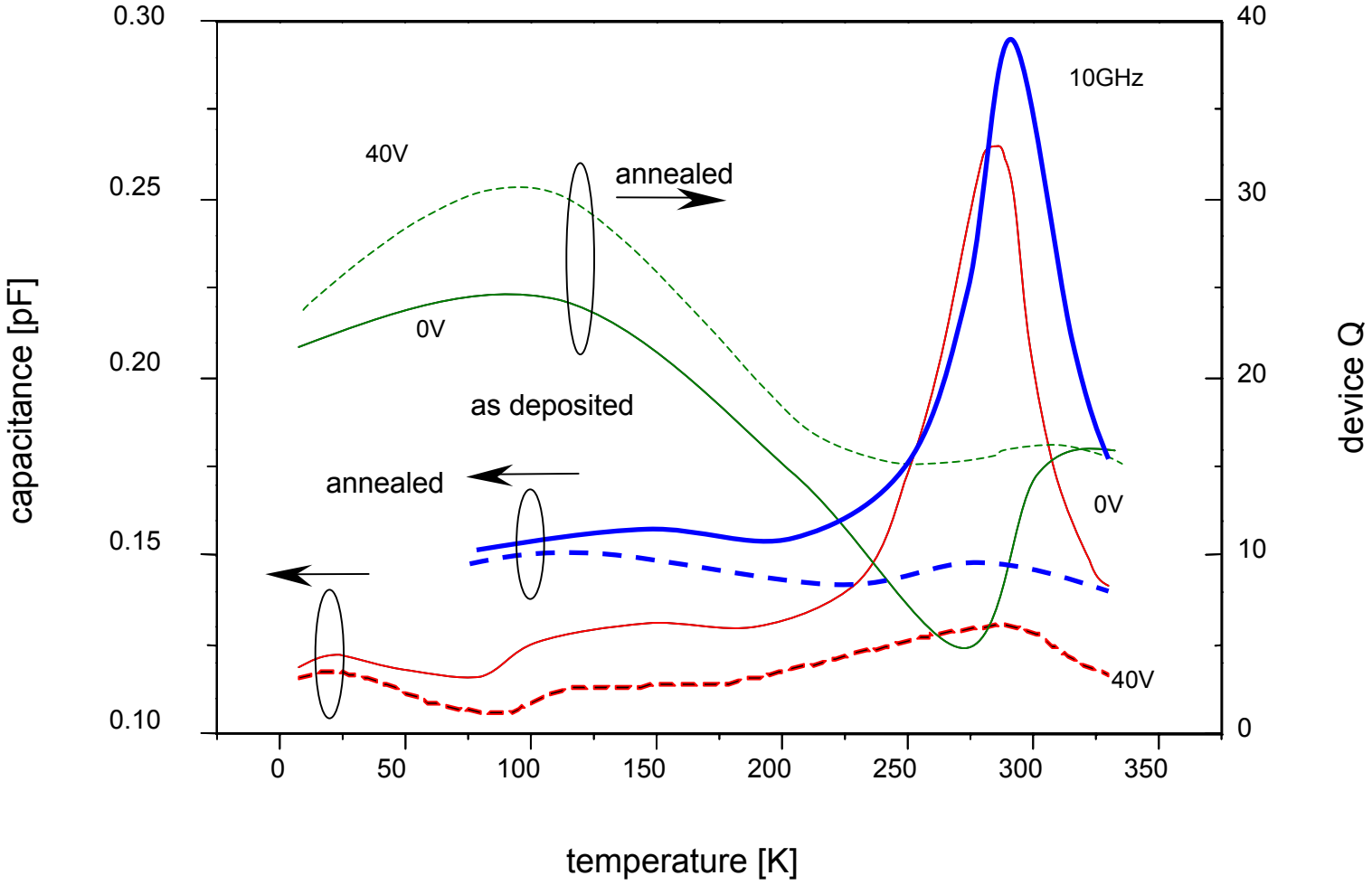
The normal lattice parameter of STO films is compressed and the in-plain lattice parameter is extended from 3.905Å of bulk STO (~1% in-plane strain).

Bias dependence of dielectric constant at 10 GHz



Room temperature dielectric constant and tuning at 10GHz

Temperature dependence of capacitance and Q



Shift in phase transition peak accounts for difference in room temperature dielectric constant and tuning.